

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference AWP/P61047/001	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/GB 03/03783	International filing date (day/month/year) 01.09.2003	Priority date (day/month/year) 10.10.2002
International Patent Classification (IPC) or both national classification and IPC F01L9/02		
Applicant LOTUS CARS LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 13.01.2004	Date of completion of this report 05.11.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Clot, P Telephone No. +49 89 2399-2724 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/GB 03/03783**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-7 as published

Claims, Numbers

1-9 received on 20.10.2004 with letter of 20.10.2004

Drawings, Sheets

1/1 as published

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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International application No. **PCT/GB 03/03783**

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

see separate sheet

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	5,6
	No: Claims	1-4,7-9
Inventive step (IS)	Yes: Claims	5,6
	No: Claims	1-4,7-9
Industrial applicability (IA)	Yes: Claims	1-9
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB 03/03783

Reference is made to the following documents:

D1: JP-A-60085209

Re Item I

The amendments filed with the letter dated 20.10.2004 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT. The amendments concerned are the following:

- amendment to claim 1
- amendment to claim 5.

■ concerning the amendment to claim 1:

The subject-matter of claim 1 results from a partial combination of earlier claims 1 and 5: the fact that the abutment surface at a lower surface of the first piston engageable with an upper surface of the second piston and the matching abutment surface at an upper surface of the second piston are conical has been excised from the combination of features of earlier claims 1 and 5.

No other form of the abutment surfaces as conical is indicated in the application: there is in particular no hint that the abutment surfaces could be flat or hemispherical.

It should be noted that flat abutment surfaces are known from document D1: an abutment surface surrounding the opening 27 is in the form of a flat shoulder against which a matching flat upper surface of the second piston 22 abuts and thereby seals the passage 27 when both pistons move together.

■ concerning the amendment to claim 5:

earlier claim 5 was dependent on claim 1 as was indicated in earlier claim 5 by the expression "as claimed in any one of the preceding claims". This expression has been dropped from present claim 5, which is drafted as an independent claim without the features of earlier claim 1. The subject-matter of this claim is not supported in the earlier application.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- 1) The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-4 and 7-9 is not new in the sense of Article 33(2) PCT.

1.1) Novelty claim 1

D1 discloses an arrangement of an internal combustion engine poppet valve and a hydraulic actuator therefor comprising
an actuator housing (casing 20);

spring means 16 for biasing the poppet valve into engagement with a valve seat therefor;

a first piston 21 of a first cross-sectional area slidable in a first chamber (large diameter bore of the casing 20) formed in the actuator housing, the first piston having a passage 27 therethrough for the flow of hydraulic fluid; and

a second piston 22 of a second cross-sectional area smaller than the first cross-sectional area slidable in a second chamber (small diameter bore of the casing 20) formed in the actuator housing, the second chamber opening on to the first chamber; wherein:

the first chamber is connectable to a pressurised hydraulic fluid supply line 8 and to a hydraulic fluid return line 9;

the second piston 22 has an upper surface engageable by a lower surface of the first piston (Fig.6); and

the first piston is configured without a passage which is both aligned with the second piston and which has a portion of constant cross-sectional area greater than the said second cross-sectional area (the piston 21 is without such passage, as its passage 27 has a cross-section smaller than the cross-section of the second piston 22); whereby:

in order to open the poppet valve: the first chamber is connected to the pressurised hydraulic fluid supply line (Fig.7) and then supplied pressurised hydraulic fluid acts initially on the first piston to give rise to a first magnitude force which is initially relayed via the second piston to the engine valve to open the valve; initially the first piston, the second piston and the engine valve all move together under the action of the first magnitude force until the first piston reaches an end stop (Fig.7 shows the first piston stopped by the seat face 33, while the second piston alone pushes the valve open); and thereafter the supplied

pressurised hydraulic fluid flows from the first chamber through the passage in the first piston to act on the second piston and to thereby give rise to a second smaller magnitude force under the action of which the second piston and the valve move together until the valve is fully open;

in order to close the previously opened poppet valve: the first chamber is connected to the hydraulic fluid return line (Fig.6) and then the biasing force applied by the spring means to the valve forces the valve to move back towards its valve seat; initially the valve and the second piston move together with the second piston expelling fluid from the second chamber via the passage in the first piston to the hydraulic fluid return line until the second piston engages the first piston; and thereafter the first piston, the second piston and the valve all move together under the biasing force applied by the spring means with the first piston expelling hydraulic fluid from the first chamber to the hydraulic fluid return line until the poppet valve engages the valve seat therefor; and the movement of the second piston relative to the first piston is limited by abutment of the upper surface of the second piston with the lower surface of the first piston.

1.2) Novelty claims 2-4 and 7-9

claim 2: the second piston 22 directly abuts with its contact portion 29 the top of the valve stem of the poppet valve 14.

claim 3: the top of the second piston 22 is designed to directly abut an inner face of the first piston 21 during the initial opening phase.

claim 4: all the chambers defined by the various bores of different diameters are according to D1 aligned.

claim 7: the drillings 23, 24 permit trapped fluid to be expelled at the stop surface, whereby this fluid is directed to the fluid reservoir from which it can be relayed, through the pump, to the first chamber.

claim 8: the valve spring acts according to D1 between a collar (Fig.6, without reference sign) attached to the poppet valve and a surface provided on the cylinder head.

claim 9: claim 9 contains references to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here. The reference to the drawing does not clearly state any structural feature other than those disclosed in D1, so that such an arrangement is regarded as disclosed in D1, Fig.7.

2) Concerning clarity:

The disclaiming feature on page 8, lines 2-25 is in contradiction with the sole

embodiment of the application:

- the disclaiming feature requires that **the first piston does not have a passage** which is both aligned with the second piston and which has a portion of constant-cross sectional area greater than the second cross sectional area;
- the first piston however includes, according to the sole embodiment, beyond the opening 111 on its bottom surface at the location pointed on by reference sign 111 on the drawing, also a hollow portion in which the chamber 112 is provided and which communicates with the opening 111, this hollow portion constituting a passage within the first piston of greater section than the section of the second piston 15. **The first piston thus has a passage** which is both aligned with the second piston and which has a portion of constant-cross sectional area greater than the second cross sectional area

In view of this contradiction, the object of claim 1 is not supported in the description (Art.6 PCT).

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CLAIMS

1. An arrangement of an internal combustion engine poppet valve and a hydraulic actuator therefor
5 comprising:
 - an actuator housing;
 - spring means for biasing the poppet valve into engagement with a valve seat therefor;
 - a first piston of a first cross-sectional area
10 slidable in a first chamber formed in the actuator housing, the first piston having a passage therethrough for the flow of hydraulic fluid; and
 - a second piston of a second cross-sectional area smaller than the first cross-sectional area slidable in
15 a second chamber formed in the actuator housing, the second chamber opening on to the first chamber; wherein:
 - the first chamber is connectable to a pressurised hydraulic fluid supply line and to a hydraulic fluid return line;
 - 20 the second piston has an upper surface engageable by a lower surface of the first piston; and
 - the first piston is configured without a passage which is both aligned with the second piston and which has a portion of constant cross-sectional area greater
25 than the said second cross-sectional area; whereby:
 - in order to open the poppet valve: the first chamber is connected to the pressurised hydraulic fluid supply line and then supplied pressurised hydraulic fluid acts initially on the first piston to give rise to
30 a first magnitude force which is initially relayed via the second piston to the engine valve to open the valve; initially the first piston, the second piston and the engine valve all move together under the action of the first magnitude force until the
35 first piston reaches an end stop; and thereafter the

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supplied pressurised hydraulic fluid flows from the first chamber through the passage in the first piston to act on the second piston and to thereby give rise to a
5 second smaller magnitude force under the action of which the second piston and the valve move together until the valve is fully open;

in order to close the previously opened poppet valve: the first chamber is connected to the hydraulic
10 fluid return line and then the biasing force applied by the spring means to the valve forces the valve to move back towards its valve seat; initially the valve and the second piston move together with the second piston expelling fluid from the second chamber via the passage
15 in the first piston to the hydraulic fluid return line until the second piston engages the first piston; and thereafter the first piston, the second piston and the valve all move together under the biasing force applied by the spring means with the first piston expelling
20 hydraulic fluid from the first chamber to the hydraulic fluid return line until the poppet valve engages the valve seat therefor; and

the movement of the second piston relative to the first piston is limited by abutment of the upper surface
25 of the second piston with the lower surface of the first piston; wherein

the passage through the first piston has an opening on to the lower surface of the first piston, the said opening being surrounded by an abutment surface;

30 and the upper surface of the second piston has a matching abutment surface and the matched abutment surfaces abut each other whilst the first and second pistons move together and by abutment seal the passage through the first piston.

35

2. An arrangement of an internal combustion engine poppet valve and a hydraulic actuator therefor as claimed in claim 1 wherein the second piston directly
40 abuts the top of a valve stem of the poppet valve.

40

3. An arrangement of an internal combustion engine

poppet valve and a hydraulic actuator therefor as claimed in claim 1 or claim 2 wherein the first and second pistons directly abut each other when moving together.

5

4. An arrangement of an internal combustion engine poppet valve and a hydraulic actuator as claimed in any one of the preceding claims wherein the first chamber is formed in the actuator housing by a first diameter drilling and the second chamber is formed in the actuator housing by a second diameter drilling which is aligned with the first diameter drilling.

10

5. An arrangement of an internal combustion engine poppet valve and an actuator therefor wherein both of the abutment surfaces are conical.

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6. An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in claim 5 wherein the matched conical surfaces together act to restrict flow of fluid through the passage in the first piston as the second piston comes into abutment with the first piston and thereby soften impact of the first piston with the second piston.

25

7. An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in any one of the preceding claims comprising a passage through the actuator through which hydraulic fluid trapped between one side of first piston and a facing surface of the first chamber as the first piston approaches the end stop therefor can be relayed to the first chamber on the other side of the first piston.

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8. An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in any one of the preceding claims wherein the spring means comprises one or more valve springs acting between a collar attached to the poppet valve and a surface provided on the engine cylinder head.

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9. An arrangement of an internal combustion engine
poppet valve and an actuator therefor substantially as
hereinbefore described with reference to and as shown in
5 the accompanying drawing.

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